Maine Climate Council
Buildings, Infrastructure, and Housing Working Group

Draft Strategy Proposals (Part II) as of 3/9/2020

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Heating

1. Accelerate Maine's Transition to High-Performance Heat Pump Technology, EMT

Which MCC goal does this strategy help to achieve?
X Mitigation of greenhouse gas emissions in the State: 45% reduction by 2030, 80% by 2050
☐ Addresses adaptation and resilience to the impacts of climate change
Describe the problem/barrier that this measure will address:
Located in Climate Zones 6 and 7, Buildings in Maine must provide heat and hot water to occupants through extended periods of low temperatures. Mainers spend between $2,500-$4,000 annually for heat in a typical home.

Petroleum heating fuels (oil, kerosene, and propane) heat more than 7 in 10 residential dwellings, and most non-residential spaces. A significant portion of domestic hot water in homes and businesses is heated with petroleum fuels.

Petroleum heating fuels are the largest contributors to GHG from the Residential and Commercial sectors among Buildings.

Petroleum heating fuels are not native to Maine, are imported, and are subject to price volatility in response to global events.

Is there a model for this, either in Maine or in other jurisdictions?

New York, Washington, Oregon, and Vermont are other states aggressively promoting the transition to high-performance heat pump technology. Among them, Maine is the national leader.

What are the benefits of this solution?

Compared to other fuel-technology combinations, high-performance, air-source heat pumps offer the following advantages:

Efficiency: With ductless "mini-split" technology, high-performance heat pump systems experience extremely high efficiency in the distribution system within the building compared to hydronic, steam, or forced hot air systems. Optimized use of inverters and the refrigeration cycle enables high-performance, cold-climate heat pumps to achieve a year-long average Coefficient of Performance (COP) of 2.7, peaking at more than 3.0 during the shoulder seasons. The technology is improving year-over-year. The "grid" supply of electricity is also getting more efficient year-over year.

Cost – 2-3X less expensive to operate than electric resistance technology; less expensive to operate than fossil-fuel heating systems. Cost-effective, using Total Resource Cost test, compared to all petroleum-fueled heating systems. Switching to heat pump technology can save a typical Maine household hundreds of dollars annually on both space and water heating (see attached).

GHG – Assuming today's marginal emissions rate from ISO-New England, factoring in inefficiencies at the generator and line losses (but not imports):

(a) Compared to an oil-fired boiler, a high-performance heat pump saves ___ tons of CO2/year.
(b) Compared to a propane-fired boiler, a high-performance heat pump saves ____ tons of CO2/year.
(c) Compared to an existing, average NG-fired boiler, a high-performance heat pump saves ____ tons of CO2/year.
(d) Compared to a new, high-efficiency NG-unit, a high-performance heat pump saves ____ tons of CO2/year.
(e) Compared to a tankless coil coming off an oil-fired boiler, a heat pump water heater saves ____ tons of CO2/year.

A single, high-performance heat pump can easily displace 27.5 MMBtu per year in a typical Maine household.

Comfort and control – Heat pumps can be digitally controlled to deliver comfort. In both heating and cooling modes, they can be managed with timers or programmed to adjust to signals. For HPWHs in particular, the tanks provide the opportunity to store heat for later use as a load management strategy.

What are the costs?

<u>Heat Pumps</u>

Average cost in recent years = $3,750 for a single-head, EMT-qualifying heat pump, including equipment and installation. About 50% more for multiple-heads.

Financial incentives offered by EMT = $1,000 for a Tier 2 install and another $500 for a second Tier 2 install. $500 for a Tier 1 install and another $250 for a second head or a second Tier 1 outdoor unit.

<u>Heat Pump Water Heaters</u>

Average cost of equipment = $1,000–1,200

Incremental cost = $600-800

Installation cost = $300-600

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Increased electricity costs more than offset by lower petroleum fuel costs.

Some share of future grid upgrades will be attributable to this strategy.

What is the timeframe for implementation? Short-term, mid-term, or long-term?

- When does implementation begin and what is the expected duration?

Immediate/ongoing.

- When is the outcome realized?

TBD

What are some Maine-specific barriers to implementation (resources, timeframe, etc.)? Maine-specific advantages

For the next 3 years, EMT and MaineHousing have sufficient funding to provide incentives or full project costs for approximately 20,000 units per year. Beyond Year 3, EMT may need to re-allocate existing revenue streams to this objective or find new funds. Beyond Year 5, EMT may have no funds to promote this objective unless decisions are made at the PUC and/or the Legislature to authorize funding.

What populations, communities, or sectors will benefit from this strategy? Who might be disadvantaged by the strategy?

Consumers: Low Income – Single Family Homes show an SIR > 1 and the potential to save considerable money for the residents. Heat pump technology, using mini-splits or VRFs, may also be a suitable application in Affordable Housing/apartments. All residential SFH. Most commercial buildings.

Vendors: Small businesses that sell/install/service heat pumps and supply houses (such as FW Webb).

Competitors: Incumbent fuel suppliers and traditional equipment vendors may compete with heat pumps/electricity (although many now offer heat pump equipment).

Existing resources/data that could help implement this strategy:

45,000 high performance heat pumps and 25,000 heat pump water heaters have been installed with assistance from EMT programs. These products and programs have been studied in Maine and Vermont and other states. Analysis confirms that the products work well in the Maine climate and save money at current prices.

- Are there major data gaps related to this strategy?

  There is limited data on the prevalence of tankless coil systems used for producing domestic hot water.

Modeling suggestions:

Model the effects of installing 2 high-performance EMT-qualifying heat pumps per home for every SFH and condo in Maine.

Model the effects of supplying 75% of non-residential space heating using heat pump technology.

Model the technical potential of HPWHs in Maine out to 2050, including replacing ERWH and tankless coils, accounting for the lives of investments and opportunities for replacement on burnout throughout this timeframe. Estimate the number of unconditioned basements in Maine.

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Model the effects of installing a HPWH in 75% of Maine homes.

Model the GHG savings/$ spent for heat pumps vs. weatherization.

Are there rules or legislation that might help enact this strategy?

Consider these actions:

1. Extend funding beyond 2025 for EMT and MaineHousing financial incentive programs
2. Set minimum HSPF ratings (i.e., "appliance standards") for the sale of heat pumps and HPWH in Maine
3. Offer tax credits on the purchase of qualifying models
4. Adopt provisions in the building code governing new construction for residential and commercial buildings for both space heating and water heating
5. Require open source controls on heat pump water heaters to enable future load management programming

Building Envelope

1. Roadmap to reach net zero carbon new construction by 2030 or 2035, with mechanisms for steadily increased compliance, D. Voorhees

Proposal Components:
A) Establish a target for Maine building energy codes to be net zero carbon by 2035 through incremental improvements every three years (use model codes to the extent they meet that trajectory.)
B) Evaluate code compliance every three years (Efficiency Maine), use measured compliance levels to set benchmarks for improvement, and target resources (Efficiency Maine and Maine Code Bureau) toward actions to achieve those benchmarks (e.g. training or other actions).

Which MCC goal does this strategy help to achieve?

X Mitigation of greenhouse gas emissions in the State: 45% reduction by 2030, 80% by 2050

☐ Addresses adaptation and resilience to the impacts of climate change

Describe the problem/barrier that this measure will address:

- Energy efficiency in new construction is one of the most cost-effective carbon mitigation strategies, however many barriers prevent their full employment, including:
  - Lack of awareness and skills among some segments of construction industry
  - Lack of enforcement support and/or training in some communities
- We lack information about actual construction practices and compliance with existing codes (let alone new codes that will be adopted every several years)
- Energy efficiency standards will need to increase over time to meet climate & energy goals

Is there a model for this, either in Maine or in other jurisdictions?

Yes. Washington State and Vermont have similar code roadmap approaches, with long-term target dates for energy codes and strategies to make steady progress in shorter-term blocks.

- Washington law requires codes in 2030 to achieve 70% net energy reduction over 2006 codes
- Vermont's comprehensive energy plan directs all new construction to be zero carbon by 2030

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Many states measure code compliance, some states make it a regular program. The procedures for measuring compliance through field studies are well understood. (The US DOE is currently conducting residential energy code compliance studies in 10 states.) In Rhode Island, efficiency program administrators spend money on increasing code compliance (and get "credit" for the savings against their three-year efficiency plans.)

Other states also do more robust training and education for the building code, at least to code officials, but also in cases to construction industry.

What are the benefits of this solution?

- Increased efficiency and indoor air quality of new buildings **lowers energy costs** significantly and ***improves health***
- Increased health, safety and affordability benefit all taxpayers through **reduced burden on social systems** (from emergency room visits to fire response to LIHEAP subsidies).
- Long-term **predictability** for building industry – understanding that codes will continue to be updated every several years helps them invest in continuous improvement & education
- Creates regular **real-world information** about the actual energy efficiency of new construction
- Increased funding for actions that increase the real-world use of the code, actions that can be **targeted** to where they are most needed
- Leverages **expertise** at Efficiency Maine, increases **partnership with Code Bureau**

What are the costs?

- Code compliance studies could cost $100,000-$200,000 every three years
- Upfront construction costs would be offset by energy savings if we continue to use model codes
- Training would scale based on the needs (e.g. code compliance baseline and degree of change in each code update cycle) – but could range between $50,000 - $100,000 per year.

What is the timeframe for implementation? Short-term, mid-term, or long-term?

- When does implementation begin and what is the expected duration?

Starts immediately with baseline code compliance study, setting benchmarks for compliance. Training will be needed in 2020 around the 2015 update. Anticipating the adoption of the 2021 code in 2022, this framework could be integrated into the next Efficiency Maine Triennial plan (2022).

- When is the outcome realized?

Pathway/roadmap leads to zero carbon standards by 2035, but training and education likely be needed to achieve high compliance in years after that.

What are some Maine-specific barriers to implementation (resources, timeframe, etc.)? Maine-specific advantages?

It is likely that compliance levels are lower, and need for training and education higher, in Maine's smaller and more rural communities. This can be remedied by Efficiency Maine and the Code Bureau targeting training or other compliance-increasing strategies/resources at the communities that most need them.

Getting squarely on a pathway of periodic code updates coupled with targeted training or other compliance strategies will take time. This proposal is appealing because it is a "start now", slow & steady, approach to a big problem. We won't get everything right immediately, but if we start now, we have time.

What populations, communities, or sectors will benefit from this strategy? Who might be disadvantaged by the strategy?

Many building industry professionals will benefit from more uniform application of the building energy code. Builders who build to the code will be less likely to be undercut in the market by those who don't.

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Households are the biggest winners, with lower energy costs. New homes today are the 15 year-old homes of 2035, so over time building codes directly benefit a larger and larger segment of the population.

Existing resources/data that could help implement this strategy:

- Are there major data gaps related to this strategy?

A key feature of this proposal is generating real-world data about code compliance so that resources to increase the use of the code can be targeted. Let's put our resources where they are demonstrably needed, to conserve taxpayer/ratepayer spending on programs.

Modeling suggestions:

Increased efficiency of the total building stock above a baseline (e.g. energy efficiency in codes increases X% every 3 years times compliance increasing Y%, times square footage built each year.)

Are there rules or legislation that might help enact this strategy?

- Legislative target for 2035 of net zero building code adoption, as compliment to existing requirement for code updates according to model code cycles
- Legislative direction for Efficiency Maine to measure code compliance, set benchmarks for increasing compliance, and allowing programs that increase compliance to count in its Triennial Plan.
- Training & education program development in partnership between Efficiency Maine and Code Bureau, with room for flexibility over time to respond to real-world data on compliance.

2. Fuel-neutral funding for energy efficiency programs to better reduce heating oil use in existing buildings, D. Voorhees

Proposal: Extend energy efficiency surcharge now levied on electricity and natural gas to heating oil and propane, using revenue to fund energy efficiency and weatherization programs that reduce heating fuel use –programs which are now a) too limited and b) funded by electricity ratepayers.

***** Many of the proposals submitted to BIH to-date could only be implemented if there were additional resources available.**

Which MCC goal does this strategy help to achieve?

X Mitigation of greenhouse gas emissions in the State: 45% reduction by 2030, 80% by 2050

☐ Addresses adaptation and resilience to the impacts of climate change

Describe the problem/barrier that this measure will address:

- Maine's resources for reducing heating fuel use are mismatched against our need, and create inequities in energy markets
- Programs to fund heating fuel reduction in buildings are woefully inadequate to the scale of the challenge: most of the funds come from RGGI, which generates $10 M year (enough to provide core efficiency support to less than 1% of households in need).
- Heating fuel markets do not contribute to Efficiency Maine program funding, unlike electricity and natural gas. RGGI funds are ultimately paid by electricity consumers.
- Innovative strategies to increase weatherization/efficiency and reduce fuel use—such as super-facilitated

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consumer financing—are stymied by lack of funds.

Is there a model for this, either in Maine or in other jurisdictions?

Vermont is the closest parallel, with a small heating fuel efficiency surcharge. Several other states allow electricity ratepayer funds to be used for efficiency measures that reduce heating fuel use (which is an alternative strategy Maine could consider.)

Of course most states do not have nearly the high dependence on unregulated fuels that Maine does. Only Vermont and New Hampshire come close (with moderately high levels in Massachusetts, upstate New York and parts of the upper mid-west.)

What are the benefits of this solution?

- Significant reductions in heating fuel use, lowering energy costs and emissions while increasing public health
- Economic benefits through reduced flow of dollars out of Maine economy (translating to new jobs in building efficiency and especially in the larger economy)
- Financing strategies could reduce the total cost of programs for middle (and upper) income homes, leaving more resources for low-income households.
- Less reliance on RGGI funds could make those funds more available for beneficial electrification (with less distortion of energy markets; e.g. less need for fuel markets to fund electrification and electric ratepayers to fund heating fuel reductions.)

What are the costs?

- An efficiency surcharge of 5 cents/gallon would raise roughly $25 million/year
- Assuming Efficiency Maine continues to achieve a benefit to cost ratio of roughly 2:1, the surcharge would have a net present benefit of roughly $40-45 million per year
- The surcharge would have some economic impact, but pale in comparison to natural fluctuations in heating fuel prices, which can go up or down by 5 cents/gallon on a weekly basis, and by $1/gallon on an annual basis.
- Heavy heating low-income households would pay a inequitable share of the cost of the surcharge, which must be remedied through a disproportionate investment of the funds on weatherizing low income households.

What is the timeframe for implementation? Short-term, mid-term, or long-term?

- When does implementation begin and what is the expected duration?
- When is the outcome realized?

This proposal could be started in 2021 through an act of the legislature. Heating oil use crept up the last year data is available after a decade of declines. Heating oil prices are also relatively low right now. That makes it a perfect time to begin increased investment in reducing heating fuel dependency, to better insulate (pun intended) Maine households from future heating costs.

What are some Maine-specific barriers to implementation (resources, timeframe, etc.)? Maine-specific advantages?

- Maine's ability to increase efficiency of buildings and heating systems

What populations, communities, or sectors will benefit from this strategy? Who might be disadvantaged by the strategy?

As noted above, the strategy will be most equitable if funds are invested aggressively in low-income households and communities less able to convert away from heating fuel. This should include an emphasis on rural communities, where access to building improvement services are more limited.

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Existing resources/data that could help implement this strategy:
- Are there major data gaps related to this strategy?

Modeling suggestions:

- Increased rate of building efficiency, using existing Efficiency Maine performance metrics
- Public health benefits of building efficiency improvements can now be estimated much more robustly

Are there rules or legislation that might help enact this strategy?

Authorizing legislation would be needed for the surcharge and directing its use

Legislation could also include directives for utilities to participate in financing programs developed in coordination with Efficiency Maine (e.g. on bill financing with capital from Efficiency Maine)

Electricity Conservation and the Grid

1. Maximize the Efficiency of Electricity Use and the Grid, EMT

Which MCC goal does this strategy help to achieve?
- **X** Mitigation of greenhouse gas emissions in the State: 45% reduction by 2030, 80% by 2050
- ☐ Addresses adaptation and resilience to the impacts of climate change

Describe the problem/barrier that this measure will address:

- Significant GHG emissions associated with the inefficient use of electricity (both at the equipment/measure itself and based on location/timing of electricity use on the grid)
- Grid challenges associated with widespread beneficial electrification (i.e., investments in transmission and distribution (T&D) infrastructure required to meet increased demand and integrate new supply can involve significant financial, logistical, and political undertakings). Reducing and shifting demand mitigates these needs.
- MACE (Maximum Achievable Cost-Effective, also sometimes called the "all cost-effective" mandate) funding for EMT programs is established/required by statute and presumes PUC funding approval every 3 years. If MACE policy is eliminated, energy and GHG savings would be lost.

Is there a model for this, either in Maine or in other jurisdictions?

- Efficiency Maine Trust – Triennial Plan III and Triennial Plan IV (current)
- Other states with "all cost-effective" mandates = California, Connecticut, Massachusetts, Rhode Island, Vermont, and Washington

What are the benefits of this solution?

- Continuation of current effective policy, leveraging existing administrative body (EMT) and private sector networks
- Cost-effective

What are the costs?

- Dependent on the size and scope of opportunity that meets the "cost-effectiveness" standard. Prior years

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have been on the order of $40-50 million/year in program funding.
- Introducing more “load management” to maximize the efficiency of the grid itself may incur incremental costs to the current energy conservation programs

What is the timeframe for implementation? Short-term, mid-term, or long-term?

- Short term and mid-term

What are some Maine-specific barriers to implementation (resources, timeframe, etc.)? Maine-specific advantages?

Barriers
- EMT’s self-imposed limits on the pace of retrofitting

Advantages
- Programs are well-established, third-party evaluated, reported, generally well understood and appreciated by stakeholders and policymakers.
- Programs save more money than they cost and are market-ready
- Value of saved energy has a multiplier effect in local economy

What populations, communities, or sectors will benefit from this strategy? Who might be disadvantaged by the strategy?
- Benefits: all sectors
- Disadvantaged: Certain sectors of the economy face steeper barriers to participate in energy conservation programs for a variety of reasons (e.g., limited discretionary income, limited time/resources, limited inventory/services in their area). Programs can be designed to overcome these barriers by creating tiered financial incentives and targeting outreach efforts to the affected groups/areas.

Existing resources/data that could help implement this strategy:

- Avoided Energy Supply Cost Study for New England (2018), as updated from time to time;
- Efficiency Maine Trust Technical Reference Manuals (for commercial and residential measures).

Modeling suggestions:

- Current MACE potential for industrial sector and cannabis sector

Are there rules or legislation that might help enact this strategy?

- Electric Efficiency Programs (continue MACE)
  - Review ineligibility of T&ST customers
  - Amend or remove the 4% cap on funding
  - Remove EMT’s prohibition on program participation from cannabis industry
- Appliance Standards
  - Expand list of covered products (e.g., Distributed Energy Resources – DERs)
  - Enhance compliance strategies
- Utility Rates
  - Explore rates reflecting value of load management and conservation

Program Ideas - expansion of existing EMT programs (not requiring rules/legislation):
- More aggressive consumer education and outreach
- More aggressive harvest of retrofit opportunities

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2. A Policy Brief on Electrifying Maine's Energy Needs, K. Aikin

A Policy Brief on Electrifying Maine's Energy Needs

To begin with, Maine should adopt strategies that can be embraced by all sides. To address climate change, we can no longer pit North Woods vs. Portland; Rural vs. Urban; etc. Everyone must benefit, and everyone must contribute.

It is not enough just to build more renewables. We must innovate across the full spectrum of solutions. In addition to new generation, we must adopt innovations in transmission, distribution, load management, and storage. These systems must work together to address multiple challenges at the same time. A broad, creative and integrated approach is the key to efficiency, cost effectiveness, avoided waste, and redundancy.

- We will be hard pressed to put 500 industrial wind turbines (3 times current levels) and their transmission lines into the North Woods. It is better to prepare for the next generation of offshore wind resources and technologies that can contribute materially to our generation mix and add to our economic vitality by exporting advanced engineering to the rest of the world, while continuing to ensure that land-based wind projects meet economic, energy, and environmental criteria

- Well distributed solar power has the potential to expand throughout the grid. When solar power is properly sited, interconnected, compensated with clear rules for ownership, and integrated with energy storage, it can provide renewable generation while also reducing congestion in distribution networks. It can also add value to individual customers and increase resiliency.

- While emphasis on storage is appropriate, storage should be combined with system controls to balance the grid and make the entire system more efficient by increasing grid capacity and reliability, Battery storage costs have evolved rapidly and projections show a decline in capital costs, with cost reductions by 2025 of 10-52% but we should not count on these assumptions to make long-term policy decisions. Innovation in storage technologies is crucial to making all forms of intermittent renewable power feasible and economical. Maine should evaluate a host of different solutions, some in use and others being developed. These include newer lithium ion chemistries, flow batteries, super-capacitors, compressed air, flywheels, and pumped storage, as well as utility-scale and distributed storage. The state should experiment with pilot sites, favored pricing, university support, and funding subsidies to become a leader in these technologies.

- Computerized, automated grid controls must link all components of the system. Controls allow us to take best advantage of the flexibility available from the mix of loads and variable flows that renewables generate. Automated management and timing of the load, including responsive demand that can make the most of low-cost intermittent generation, is a low-cost way to eliminate overbuilding of generators and storage, reduce redundancy and save billions of dollars.

SPECIFIC POLICY PROPOSALS:

1. REGULATORY REFORMS TO ACHIEVE A CLEAN AND RESILIENT GRID. Despite Maine's commitment to climate and renewable energy targets, it has not yet empowered state agencies to fully support these targets in their decision-making. State agencies' enabling statutes

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are silent on climate or give only weak prioritization in agency decisions. For example, the Maine Public Utilities Commission charter mandates that the Commission prioritize the immediate rate impacts and a company's opportunity to earn a fair return, rather than the full suite of costs and benefits related to energy over a longer time horizon. Maine should update all agency mandates to assign their responsibility to regulate in alignment with state policy goals to minimize climate impacts and consider the full costs of energy investments and other climate impacts in all decisions.

2. MAINE RENEWABLE ENERGY TECHNOLOGY INVESTMENT BANK: Economist Richard Silkman has proposed creating a Maine Electric Generation Authority. It has merit. The question is whether the state itself really needs to be a generator and are there alternative market designs that would better align with Maine's public policies and goals. An alternative approach would be to create a Maine Renewable Energy Investment Bank (MREIB) modeled after the Maine Technology Institute. The bank could borrow money at, say, 2.5% and lend it out at, say, 2.75% for projects that provide the greatest value to the grid. This would expand technology businesses, new as well as old, and draw capital into the state for projects that meet our renewable energy goals and that promote economic activity and provide access to rooftop and community solar to low- and moderate-income residents of the state.

3. PUBLISH DISTRIBUTION LEVEL LOAD PROFILES: Require utilities to publish information about load levels and line congestion so that developers may better focus their investments where needed in the grid. New renewable energy should be positioned where it is most effective to modernize the grid and support the massive expansion required to decarbonize Maine's energy supply.

   Vermont and New Hampshire have already adopted rules to make such information public. Maine should do the same. Utilities should release granular data at the distribution level with details of load profiles and grid conditions over a 10-year planning period for every distribution circuit in the state. This will expand opportunities for private and public investment in Non-Wire Alternatives (NWA's).

4. VALUE DISTRIBUTED ENERGY PROJECTS BASED ON GRID VALUE: Pay a small bonus to renewable energy developers to reward them for well-designed projects in locations that provide the greatest value to the grid and that improve the functionality of other grid investments. Providing less than a penny per kWh to such projects can unlock billions of dollars of private investment.

5. BENEFICIAL ELECTRIFICATION: Expand beneficial electrification by promoting heat pumps and thermal storage bundled with associated building efficiency improvements, and electrify other energy needs for industrial applications, process heat, and transportation. These new loads should be inter-connected and made interactive and responsive as recommended in policy six

6. SUPPORT INTERACTIVE AND SMART LOADS: Adopting Time of Use (TOU) and real-time valuation of electric supply and demand can unlock private investment---both behind and in-front of the meter. A grid transformed in this way can make nearly 40% of loads interactive with supply that is responsive to pricing signals, thus eliminating redundant storage and generation.

   The Department of Energy is focused on Transactive Energy as a key strategy for grid modernization. Many states are also exploring methods for valuing electricity to users based

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upon the real-time cost of delivering power at the moment of demand. Companies throughout the world are developing these interactive and smart grid technologies.

Maine could invest in these opportunities through the Energy Investment Bank. The Maine Efficiency Trust is already supporting limited pilot programs, combining beneficial electrification, distributed energy, storage, and cybersecurity in an integrated fashion. If these efforts were expanded exponentially, Maine could become a national leader by adopting such technologies throughout its grid.

Interactive, automated controls are relatively inexpensive ways to save billions on redundant storage and generation, while making the grid more responsive to both customers and utilities alike.

7. PROMOTE COMMUNITY ENERGY PROJECTS AND MICROGRIDS: While investing in renewable generation and interactive load controls can make a profound difference, community microgrids can as well. The Investment Bank could provide low-cost capital for local projects sponsored by communities and private entities to bring new community energy sources into the system and allow individual users to participate in the solution.

3. Beneficial Electrification and Intelligent Grid Controls, K. Aikin

Introduction

As we expand our renewable energy generation capability the grid will become much more variable. This can be mitigated by massive amounts of energy storage, export of power (requiring massive transmission lines) or a program to build what is called by some as the "next, next grid"

To get to a zero-carbon future we also need to electrify the entire energy system. This includes making every building fully electric including transportation. However, when we do this the peak loads on the system will greatly expand, with up to 3 times increase in grid infrastructure, requiring investment in the electrical grid costing above 20 billion dollars.

The addition of renewable generation that is variable and electrification of most of our energy needs can work together intelligently to balance each other. This will be the lowest cost system and is technological feasible.

The new loads added to the system need to be controlled intelligently and provide balancing support to the grid working in concert with renewable generation. To accomplish this transformation to full electrification efficiently upwards of 40% of the systems loads need to be adaptable. This means that the loads can intelligently defer or augment loads at the correct times helping balance the variable renewable energy generation profile.

There are four components to this proposal

- Expansion of the electrification of energy loads (space heating and transportation) modeled upon the work by the Maine Energy Efficiency Trust
- Addition of Thermal storage for space heating making current electric heat pumps more adaptable and able to contribute to electric grid balancing.
- Introduction of at least Time of Use (TOU) and Demand pricing of retail electricity or ideally real-time pricing that would incentivize smart energy use and the introduction of intelligent controls. This would make smart controls a good investment as well as both electrical storage and thermal storage technologies.

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- Investment in intelligent next generation controls that can allow loads to contribute to the balancing of variable generation and loads.

This would provide value to the entire grid; the grid would become greener with more energy use being electrified and more intelligent and easier to control renewable generation. It would also cost less than providing massive amounts of energy storage that even at projected cost reductions (if they happen) will be cost prohibitive costing greater than 50 billion dollars.

1. **Which MCC goal does this strategy help to achieve? [Mitigation of greenhouse gas emissions in the State; 45% reduction by 2030, 80% by 2050, Addresses adaption and resilience to the impact of climate change.]** Address greenhouse gas emissions by increasing the percentage of renewable energy in the grid. It would increase resilience by providing increased distributed energy throughout the grid and the controls to "keep the lights on".

2. **What problems/barriers will this strategy address?**
    a. the control of variable generation.
    b. The challenge moving to a fully electrified energy system
    c. The cost of battery storage

3. **Is there a model for this strategy, either in Maine or in other jurisdictions? No**, although the Grid Wise Architecture Council (GWAC) is the main advisory board for grid modernization for the Department of Energy (the author is a member of the council) has plans for this transformation.

4. **What are the benefits of this strategy?** Expanded integration of renewable energy generation projects and electrification of energy use.

5. **What are the costs of this strategy?** I estimate that this would cost about 800 million dollars over 20 years that is only 1-5% of the estimated cost of the lowest energy storage and grid infrastructure scenario.

6. **What is the timeframe for implementation (short- , mid- , or long-term)?** 5-20 years

7. **What are the Maine-specific barriers to implementation (e.g., legal, resources, standard practice, supply chain, workforce capacity, etc.)?**
8. Regulations concerning variable retail pricing
9. This is an entire new idea that would require careful study but the technology is becoming available at scale.
10. **What populations, communities, or sectors will be impacted by this strategy?** The electrical grid and all communities served

11. **Identify existing resources/data that could help develop and implement this strategy.** The Department of Energy, Grid Wise Architecture Council, private Industry and the National labs.

12. **Modeling suggestions for this strategy.** Much has already been done. Modeling is ongoing by the National Labs, DOE and private industry.

4. Granular Distribution Grid Data, K. Aikin

Introduction
The state of Maine now has a Non-Wires Alternative Coordinator. At this time it is unsure how that new position will improve the injection of distributed energy into the grid in the form of NWA's but one area of concentration should be an effort of providing more data to renewable energy developers so they can propose interconnection of their projects not only in areas that can accept the power but places that can provide the most value to the grid.

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This requires information from Maine utilities detailing the loads, generation and capacity of all of their distribution lines. The States of New Hampshire and Vermont provided limited information already and this can be duplicated in Maine and should be greatly expanded.

This proposal could also be expanded by providing a state wide study funded by the NWA coordinator to survey and locate areas for high impact projects so that developers can focus on those areas.

1. **Which MCC goal does this strategy help to achieve? [Mitigation of greenhouse gas emissions in the State; 45% reduction by 2030, 80% by 2050, Addresses adaption and resilience to the impact of climate change.]** Address greenhouse gas emissions by increasing the percentage of renewable energy in the grid.
2. **What problems/barriers will this strategy address?**
    a. The lack of information of where renewable energy projects can be sited within the distribution grid easily.
    b. The challenge of long interconnection cues.
    c. The challenge of prioritizing grid investments.
3. **Is there a model for this strategy, either in Maine or in other jurisdictions?** Yes, Vermont and New Hampshire
4. **What are the benefits of this strategy?** Expansion of renewable energy generation projects in the places where they do the most good for the grid infrastructure.
5. **What are the costs of this strategy?** The cost would be the cost of implementation of a web portal to display the information and perhaps some soft costs by the utilities.
6. **What is the timeframe for implementation (short- , mid- , or long-term)?** 1 year
7. **What are the Maine-specific barriers to implementation (e.g., legal, resources, standard practice, supply chain, workforce capacity, etc.)?** Federal Energy Regulatory Commission rules and push back from the Utilities.
8. **What populations, communities, or sectors will be impacted by this strategy?** The electrical grid and all communities served
9. **Identify existing resources/data that could help develop and implement this strategy.** Maine Public Utilities Commission
10. **Modeling suggestions for this strategy:** System Engineering modeling of the value renewable energy at the distribution level. Multiple companies can provide this information. My company Introspective Systems is developing software to accomplish this on a granular level. But companies like Stantec and Burns and McDonnel can do this on a project by project basis.

5. Maine Renewable Energy Investment Bank (MREIB), K. Aikin

Introduction

The objective of this strategy is to expand the ability to finance large scale Renewable Energy infrastructure and Technology infrastructure placed upon the grid either behind or in front of the meter. This program can be modeled after the existing Maine Technology Institute requiring significant participation from outside investment. The program could also be designed to prioritize investments in grid infrastructure that provide the most capability and in early years support pilot projects.

1. **Which MCC goal does this strategy help to achieve? [Mitigation of greenhouse gas emissions in the State; 45% reduction by 2030, 80% by 2050, Addresses adaption and resilience to the impact of climate change.]** Address greenhouse gas emissions by increasing the percentage of renewable energy.
2. **What problems/barriers will this strategy address?**
    a. The gap in financing resources for renewable energy projects
    b. The barrier of getting investment dollars into technology businesses that can make fundamental improvements to renewable energy and grid infrastructure technology but are hampered by lack of outside investment

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c. One of the largest barriers in new technology development is the implementation of pilot projects. This program could be used to greatly expand the work of the Maine Efficiency Trust in promoting pilot projects. Maine could be seen as a leader in the renewable energy technology space.
d. Utilities are low investment enterprise and the MREIB would provide another funding source at reasonable rates beyond utility rate recovery.

3. **Is there a model for this strategy, either in Maine or in other jurisdictions?** Yes, Both the Maine Technology Institute and the Efficiency Maine Trust.
4. **What are the benefits of this strategy?** Expansion of renewable energy generation and technology investments.
5. **What are the costs of this strategy?** The only cost would be the cost of implementation that could be gotten with a small percentage added to fairly low bond money secured by the State of Maine.
6. **What is the timeframe for implementation (short- , mid- , or long-term)?** 2 years with an investment horizon of 30 years
7. **What are the Maine-specific barriers to implementation (e.g., legal, resources, standard practice, supply chain, workforce capacity, etc.)?** None anticipated
8. **What populations, communities, or sectors will be impacted by this strategy?** All residents
9. **Identify existing resources/data that could help develop and implement this strategy.** Efficiency Maine Trust and Maine Technology Insitute although greatly expanded staff and resources
10. **Modeling suggestions for this strategy.**
    a. State Economist to look at the costs of implementation and availability of bond money and cost
    b. Maine Technology Institute estimate of resources required.

6. Value Distribution Level Renewable Energy Projects Based on Value, K. Aikin

Introduction

The objective of this strategy is to expand the ability to finance large scale Renewable Energy infrastructure and Technology infrastructure placed upon the grid either behind or in front of the meter. This program can be modeled after the existing Maine Technology Institute requiring significant participation from outside investment. The program could also be designed to prioritize investments in grid infrastructure that provide the most capability and in early years support pilot projects.

1. **Which MCC goal does this strategy help to achieve? [Mitigation of greenhouse gas emissions in the State; 45% reduction by 2030, 80% by 2050, Addresses adaption and resilience to the impact of climate change.]** Address greenhouse gas emissions by increasing the percentage of renewable energy.
2. **What problems/barriers will this strategy address?**
    a. The gap in financing resources for renewable energy projects
    b. The barrier of getting investment dollars into technology businesses that can make fundamental improvements to renewable energy and grid infrastructure technology but are hampered by lack of outside investment
    c. One of the largest barriers in new technology development is the implementation of pilot projects. This program could be used to greatly expand the work of the Maine Efficiency Trust in promoting pilot projects. Maine could be seen as a leader in the renewable energy technology space.
    d. Utilities are low investment enterprise and the MREIB would provide another funding source at reasonable rates beyond utility rate recovery.
3. **Is there a model for this strategy, either in Maine or in other jurisdictions?** Yes, Both the Maine Technology Institute and the Efficiency Maine Trust.
4. **What are the benefits of this strategy?** Expansion of renewable energy generation and technology investments.

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5. **What are the costs of this strategy?** The only cost would be the cost of implementation that could be gotten with a small percentage added to fairly low bond money secured by the State of Maine.
6. **What is the timeframe for implementation (short- , mid- , or long-term)?** 2 years with an investment horizon of 30 years
7. **What are the Maine-specific barriers to implementation (e.g., legal, resources, standard practice, supply chain, workforce capacity, etc.)?** None anticipated
8. **What populations, communities, or sectors will be impacted by this strategy?** All residents
9. **Identify existing resources/data that could help develop and implement this strategy.** Efficiency Maine Trust and Maine Technology Insitute although greatly expanded staff and resources
10. **Modeling suggestions for this strategy:**
    a. State Economist to look at the costs of implementation and availability of bond money and cost
    b. Maine Technology Institute estimate of resources required.

Other

1. Expand Contractor Training and Certification for Net-Zero Standards, R. Patane

BUILD EFFICIENCY MAINE REFERRAL LIST OF CONTRACTORS TRAINED AND CERTIFIED IN NET-ZERO STANDARDS; LEAD SIGNIFICANT EXPANSION OF TRAINING AND CERTIFICATION PROGRAMS IN COLLABORATION WITH OTHER OF ORGANIZATIONS CURRENTLY DOING TRAINING.

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Which MCC goal does this solution (e.g., policy or program) help to achieve?

- [X] Mitigation of greenhouse gas emissions in the State: 45% reduction by 2030, 80% by 2050
- [X] Addresses adaptation and resilience to the impacts of climate change

Describe the problem/barrier that this solution will address:

(1) Homeowners and small apartment building owners have no easy way to take the first step in retrofitting or building to net-zero standards; current contractors typically represent a specific product and not a holistic problem- solving consulting approach so it can't address a multi-faceted situation (2) Contractors and code enforcement staff are not familiar with net-zero standards.

Is there a model for this solution, either in Maine or in other jurisdictions?

Many organizations in Maine train contractors and code enforcement staff

What are the benefits of this solution?

Makes resources easily available to consumers willing to retrofit or build to net-zero standards -- Efficiency Maine can be a one-stop shop for consumers making the first step

What are the costs of this solution?

Training should be free or very low cost to contractors and code staff, so cost would be the actual cost of training plus the administration of a collaboration with other training entities

What is the timeframe for implementation? Short-term, mid-term, or long-term?

- When should implementation begin and what is the expected duration?

SHORT TERM: agree on net zero standards; reach out to training entities to form partnerships

LONG TERM: build Efficiency Maine capacity to promote certified contractors and to assist to on select a contractor

- When is the outcome realized? When a consumer can easily find a trained contractor on EMs list

What are some Maine-specific barriers to implementation (e.g., legal, resources, standard practice, supply chain, workforce capacity, etc.)?

Workforce capacity: may need to recruit workers from out of state or improve retention of young Mainers who leave

What populations, communities, or sectors will be impacted by this strategy? (Where appropriate, please indicate how they may likely be impacted)

Please identify existing resources/data that could help develop and implement this strategy:

Maine community college system
Maine Building & Construction Trades Council Sanford Technical
Center and other technical schools E2Tech
Losing Job Corps
Brunswick Landing

Businesses such as Hancock Lumber and Eldredge Lumber who train employees and private contractors

Modeling suggestions: Developing a model set of standards and an apprenticeship program would make the training certification uniform

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2. Establish State Energy Corps Partnership with VISTA/AMERICORPS Program, R. Patane

ESTABLISH STATE ENERGY CORPS PARTNERSHIP WITH VISTA/AMERICORPS PROGRAM

Which MCC goal does this solution (e.g., policy or program) help to achieve?

- [X] Mitigation of greenhouse gas emissions in the State: 45% reduction by 2030, 80% by 2050
- [X] Addresses adaptation and resilience to the impacts of climate change

Describe the problem/barrier that this solution will address:

Lack of capacity in municipalities limits their ability to take action to reduce emissions

Is there a model for this solution, either in Maine or in other jurisdictions?

Montana Energy Corps Program, Lonni Starcevich, Pgm Director 406-533-6651, lonnis@mcat.org

What are the benefits of this solution?

Adds capacity and skills to municipal staffs at low or no cos; Vista volunteers add capacity to staff on climate action plans and emissions inventories; Americorps volunteers perform direct service on projects in communities such as weatherization, with emphasis on low- and moderate-income families

What are the costs of this solution?

A) Cost of managing program of recruiting, vetting, and placing Vista/Americorps volunteers in cities & towns
B) Program management can also be staffed with Vista members
C) Cost to state or municipality of each Vista/Americorps volunteer: $6500/year plus assistance finding housing

What is the timeframe for implementation? Short-term, mid-term, or long-term? Short term: negotiate w Vista

- When should implementation begin and what is the expected duration?
  Begin negotiation with Vista ASAP; recruitment of volunteers begins in February each year. Begin recruiting towns to act as sites simultaneously
- When is the outcome realized? Outcome is realized when Vista volunteers are placed; also when their work results

What are some Maine-specific barriers to implementation (e.g., legal, resources, standard practice, supply chain, workforce capacity, etc.)?

Lack of affordable housing for Vista/Americorps volunteers, who earn a little over $1,000/mo. Recruiting volunteers outside Maine or even from one town to another in Maine faces the difficulty of finding housing for them

What populations, communities, or sectors will be impacted by this strategy? (Where appropriate, please indicate how they may likely be impacted)

Low- and moderate-income households are the focus of the Vista/Americorps program, so they would be particularly Bu increasing the number of programs like weatherization, emissions inventories and climate action planning would everyone.

Please identify existing resources/data that could help develop and implement this strategy:

Maine's Office of Public Service;

- What major data gaps are related to further developing or implementing this strategy?

Energy use data from CMP has not been available; Heating and auto gas usage is similarly unavailable.

Modeling suggestions:

Easily accessible models for estimating a community's energy footprint would be a key assist to municipalities

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